
इस्पात नलिकाएँ सरचनात्मक
उपयोगों के लिये — विशिष्टि
(पाँचवाँ पुनरीक्षण)

Steel Tubes For Structural
Purposes — Specification
(Fifth Revision)

ICS 77.140.75; 91.220



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FOREWORD

This Indian Standard (Fifth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Tubes, Pipes and Fittings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1958 and revised in 1963, 1968, 1979 and 1998, respectively. While reviewing this standard, the Committee has felt it necessary to revise this Indian Standard with the following modifications:

- a) A new Grade YSt 355 has been incorporated.
- b) All amendments have been incorporated.

In the formulation of this standard, due consideration has been given to the trade practices followed in the country in this field. Due consideration has also been given to international co-ordination among the standards prevailing in different countries. Assistance has been derived from the following publications:

ISO 4200 : 1991	'Plain end steel tubes, welded or seamless — General tables of dimensions and masses per unit length', issued by International Organization for Standardization
ISO 10799-1 : 2011 (E)	Cold formed welded structural hollow sections of non-alloy and fine grain steel, Part 1 (for YSt 355 grade)
ISO 12633-1 : 2011 (E)	Hot finished structural hollow sections of non-alloy and fine grain steel Part 1 (for YSt 355 grade)
BS EN 10219-1 : 2006	Cold formed welded Structural hollow sections of non-alloy and fine grain steel (for YSt 355 grade)

This standard contains clauses **6.1.3, 9.1, 10.1** and **11.5.2** which call for agreement between the purchaser and the manufacturer.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

STEEL TUBES FOR STRUCTURAL PURPOSES — SPECIFICATION

(Fifth Revision)

1 SCOPE

This standard covers the requirements for hot finished seamless (HFS), and electric resistance welded (ERW) or high frequency induction welded (HFIW) steel tubes for structural purposes.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
228 (in parts) 1239 (Part 1) : 2004	Method of chemical analysis of steel Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (<i>sixth revision</i>)
1387 : 1993	General requirements for the supply of metallurgical material (<i>second revision</i>)
1608 : 2005/	Metallic materials — Tensile testing at ambient temperature
ISO 6892 : 1998	(<i>third revision</i>)
2328 : 2005/	Metallic materials — Tube flattening
ISO 8492 : 1998	test on metallic tubes (<i>second revision</i>)
2329 : 2005/	Metallic materials — Tube (in full
ISO 8491 : 1998	section) — Bend test (<i>second revision</i>)
4711 : 2008	Methods for sampling of steel pipes, tubes and fittings (<i>second revision</i>)
4736 : 1986	Hot-dip zinc coatings on mild steel tubes (<i>first revision</i>)
4740 : 1979	Code of practice for packaging of steel tubes (<i>first revision</i>)
10748 : 2004	Hot-rolled steel strip for welded tubes and pipes (<i>second revision</i>)
2062 : 2011	Hot rolled Low, Medium and High tensile structural steel (<i>seventh revision</i>)

3 DESIGNATION

Steel tubes covered by this standard shall be designated by their nominal bore and wall thickness (*see* Table 1). They shall be further graded as YSt 210, YSt 240, YSt 310 and YSt 355 depending on the yield strength of the material (*see* Table 2). The designation of the steel tubes shall, therefore, include the nominal bore of the tube and grade of the material.

4 SUPPLY OF MATERIAL

General requirements relating to the supply of the steel tubes for structural purposes shall conform to IS 1387.

5 MATERIAL

Steel tubes shall be manufactured through one of the following processes as given in Table 3 and shall be supplied in conditions as shown therein:

- a) Hot finished seamless (HFS);
- b) Cold finished seamless (CDS); and
- c) Electric resistance welded or high frequency induction welded (ERW or HFIW).

NOTE — Tubes made by manual welding are not covered by this standard.

6 DIMENSIONS AND WEIGHTS

6.1 The standard sizes and mass of tubes for structural purposes shall be as given in Table 1.

6.1.1 Some geometrical properties of the steel tubes are also given in Table 1 for information.

6.1.2 Tubes of thickness lower than the specified minimum thickness of tube, as shown in Table 1 shall not be permissible.

6.1.3 Tubes of thickness higher than the specified minimum thickness of tube, as shown in Table 1 may be supplied, if so mutually agreed to between the purchaser and the manufacturer.

Table 1 Sizes and Properties of Steel Tubes for Structural Purposes

(Clauses 3.1, 6.1, 6.1.1, 6.1.2 and 6.1.3)

NB	OD	Thk	Mass	Area of Cross-Section	Internal Volume	Surface		Moment of Inertia	Modulus of Section	Radius of Gyration	Square of Radius of Gyration
						External	Internal				
mm (1)	mm (2)	mm (3)	kg/m (4)	cm ² (5)	cm ³ /m (6)	cm ² /m (7)	cm ³ /m (8)	cm ⁴ /m (9)	cm ³ (10)	cm (11)	cm ² (12)
15	21.3	2	0.952	1.21	235	669	543	0.57	0.54	0.69	0.47
	21.3	2.6	1.20	1.53	204	669	506	0.68	0.64	0.67	0.45
	21.3	3.2	1.43	1.82	174	669	468	0.77	0.72	0.65	0.42
20	26.9	2.3	1.40	1.78	391	845	701	1.36	1.01	0.87	0.76
	26.9	2.6	1.56	1.98	370	845	682	1.48	1.10	0.86	0.75
	26.9	3.2	1.87	2.38	330	845	644	1.70	1.27	0.85	0.71
25	33.7	2.6	1.99	2.54	638	1 059	895	3.09	1.84	1.10	1.22
	33.7	3.2	2.41	3.07	585	1 059	858	3.60	2.14	1.08	1.18
	33.7	4	2.93	3.73	519	1 059	807	4.19	2.49	1.06	1.12
32	42.4	2.6	2.55	3.25	1 087	1 332	1 169	6.46	3.05	1.41	1.99
	42.4	3.2	3.09	3.94	1 018	1 332	1 131	7.62	3.59	1.39	1.93
	42.4	4	3.79	4.83	929	1 332	1 081	8.99	4.24	1.36	1.86
40	48.3	2.9	3.25	4.14	1 419	1 517	1 335	10.70	4.43	1.61	2.59
	48.3	3.2	3.56	4.53	1 379	1 517	1 316	11.59	4.80	1.60	2.56
	48.3	4	4.37	5.57	1 276	1 517	1 266	13.77	5.70	1.57	2.47
50	60.3	2.9	4.11	5.23	2 333	1 894	1 712	21.59	7.16	2.03	4.13
	60.3	3.6	5.03	6.41	2 215	1 894	1 668	25.87	8.58	2.01	4.03
	60.3	4.5	6.19	7.89	2 067	1 894	1 612	30.90	10.25	1.98	3.92
65	76.1	2.9	5.24	6.67	3 882	2 391	2 209	44.74	11.76	2.59	6.71
	76.1	3.6	6.44	8.20	3 728	2 391	2 165	54.01	14.19	2.57	6.59
	76.1	4.5	7.95	10.12	3 536	2 391	2 108	65.12	17.11	2.54	6.43
80	88.9	3.2	6.76	8.62	5 346	2 793	2 592	79.21	17.82	3.03	9.19
	88.9	4	8.38	10.67	5 140	2 793	2 542	96.34	21.67	3.00	9.03
	88.9	4.8	9.96	12.68	4 939	2 793	2 491	112.49	25.31	2.98	8.87
90	101.6	3.6	8.70	11.08	6 999	3 192	2 966	133.24	26.23	3.47	12.02
	101.6	4	9.63	12.26	6 881	3 192	2 941	146.28	28.80	3.45	11.93
	101.6	4.8	11.46	14.60	6 648	3 192	2 890	171.39	33.74	3.43	11.74
100	114.3	3.6	9.83	12.52	9 009	3 591	3 365	191.98	33.59	3.92	15.33
	114.3	4.5	12.19	15.52	8 709	3 591	3 308	234.32	41.00	3.89	15.10
	114.3	5.4	14.50	18.47	8 413	3 591	3 252	274.54	48.04	3.85	14.86
110	127	4.5	13.59	17.32	10 936	3 990	3 707	325.29	51.23	4.33	18.78
	127	4.8	14.47	18.43	10 825	3 990	3 688	344.50	54.25	4.32	18.69
	127	5.4	16.19	20.63	10 605	3 990	3 651	382.04	60.16	4.30	18.52
125	139.7	4.5	15.00	19.11	13 417	4 389	4 106	437.20	62.59	4.78	22.87
	139.7	4.8	15.97	20.34	13 295	4 389	4 087	463.33	66.33	4.77	22.78
	139.7	5.4	17.89	22.78	13 050	4 389	4 050	514.50	73.66	4.75	22.58
135	152.4	4.5	16.41	20.91	16 151	4 788	4 505	572.24	75.10	5.23	27.37
	152.4	4.8	17.47	22.26	16 016	4 788	4 486	606.76	79.63	5.22	27.26
	152.4	5.4	19.58	24.94	15 748	4 788	4 448	674.51	88.52	5.20	27.05
150	165.1	4.5	17.82	22.70	19 138	5 187	4 904	732.57	88.74	5.68	32.27
	165.1	4.8	18.98	24.17	18 991	5 187	4 885	777.13	94.14	5.67	32.15
	165.1	5.4	21.27	27.09	18 699	5 187	4 847	864.70	104.75	5.65	31.92
	165.1	5.9	23.20	29.50	18 465	5 189	4 818	970.00	113.40	5.63	31.72
	165.1	6.3	24.67	31.43	18 265	5 187	4 791	992.28	120.20	5.62	31.57
	165.1	8	30.99	39.48	17 460	5 187	4 684	1 221.25	147.94	5.56	30.93
150	168.3	4.5	18.18	23.16	19 931	5 287	5 005	777.22	92.36	5.79	33.56
	168.3	4.8	19.35	24.66	19 781	5 287	4 986	824.57	97.99	5.78	33.44
	168.3	5.4	21.69	27.64	19 483	5 287	4 948	917.69	109.05	5.76	33.21
	168.3	6.3	25.17	32.06	19 040	5 287	4 891	1 053.42	125.18	5.73	32.85
	168.3	8	31.63	40.29	18 218	5 287	4 785	1 297.27	154.16	5.67	32.20
	168.3	10	39.04	49.73	17 273	5 287	4 659	1 563.98	185.86	5.61	31.45

Table 1 — (Concluded)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
175	193.7	4.8	22.36	28.49	26 619	6 085	5 784	1271.39	131.27	6.68	44.63
	193.7	5.4	25.08	31.94	26 273	6 085	5 746	1416.97	146.31	6.66	44.36
	193.7	5.9	27.33	34.81	25 987	6 085	5 715	1536.13	158.61	6.64	44.13
	193.7	6.3	29.12	37.09	25 759	6 085	5 689	1630.05	168.31	6.63	43.95
	193.7	8	36.64	46.67	24 801	6 085	5 583	2015.54	208.11	6.57	43.19
	193.7	10	45.30	57.71	23 697	6 085	5 457	2441.59	252.10	6.50	42.31
	193.7	12	53.77	68.50	22 618	6 085	5 331	2839.20	293.15	6.44	41.45
200	219.1	4.8	25.37	32.32	34 471	6 883	6 582	1856.03	169.42	7.58	57.43
	219.1	5.6	29.49	37.56	33 947	6 883	6531	2141.61	195.49	7.55	57.02
	219.1	5.9	31.02	39.52	33 751	6 883	6 513	2247.01	205.11	7.54	56.86
	219.1	6.3	33.06	42.12	33 491	6 883	6 487	2386.14	217.81	7.53	56.65
	219.1	8	41.65	53.06	32 397	6 883	6 381	2959.63	270.16	7.47	55.78
	219.1	10	51.57	65.69	31 134	6 883	6 255	3598.44	328.47	7.40	54.78
	219.1	12	61.29	78.07	29 895	6 883	6 129	4199.88	383.38	7.33	53.79
225	244.5	5.9	34.72	44.23	42 529	7 681	7 310	3149.12	257.60	8.44	71.21
	244.5	6.3	37.01	47.14	42 237	7 681	7 285	3346.03	273.70	8.42	70.97
	244.5	8	46.66	59.44	41 007	7 681	7 179	4160.45	340.32	8.37	70.00
	244.5	10	57.83	73.67	39 584	7 681	7 053	5073.15	414.98	8.30	68.86
250	273	5.9	38.86	49.51	53 584	8 577	8 206	4417.18	323.60	9.45	89.22
	273	6.3	41.44	52.79	53 256	8 577	8 181	4695.82	344.02	9.43	88.96
	273	8	52.28	66.60	51 875	8 577	8 074	5851.71	428.70	9.37	87.86
	273	10	64.86	82.62	50 273	8 577	7 948	7154.09	524.11	9.31	86.59
	273	12	77.24	98.39	48 695	8 577	7 823	8396.14	615.10	9.24	85.33
300	323.9	6.3	49.34	62.86	76 111	10 176	9 780	7928.90	489.59	11.23	126.14
	323.9	8	62.32	79.39	74 458	10 176	9 673	9910.08	611.92	11.17	124.82
	323.9	10	77.41	98.61	72 536	10 176	9 547	12158.34	750.75	11.10	123.29
	323.9	12	92.30	117.58	70 639	10 176	9 422	14319.56	884.20	11.04	121.78
350	355.6	8	68.58	87.36	90 579	11 172	10 669	13201.37	742.48	12.29	151.11
	355.6	10	85.23	108.57	88 457	11 172	10 543	16223.50	912.46	12.22	149.42
	355.6	12	101.68	129.53	86 361	11 172	10 418	19139.47	1076.46	12.16	147.76

6.2 Tolerances

The following tolerances shall apply:

a) Outside diameter :

- 1) Up to and including 48.3 mm : + 0.4 mm
- 0.8 mm
- 2) Over 48.3 mm : ± 1.0 percent

b) Thickness (for all sizes) :

- 1) Welded tubes : ± 10 percent
- 2) Seamless tubes : ± Not limited
- 12.5 percent

c) Weight:

- 1) Single tube : ± 10 percent
- 2) 10 tonne lots : ± 7.5 percent

NOTE — For 10 tonne (Min) lots, the weight may be done in convenient smaller lots and added up at the option of the manufacturer.

7 WORKMANSHIP

The tubes shall be cleanly finished and reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall

be cut cleanly and square with the axis of tube, unless otherwise specified.

Surface imperfections such as handling marks, light die or roll marks, or shallow pits shall not be considered as defects provided the imperfections are removable within minimum wall thickness permitted. Removal of such surface imperfections is not required. Welded tubing shall be free of protruding metal on the outside surface of the weld seam.

8 GALVANIZING

If the tubes are required in galvanized condition the zinc coating on the tubes shall be conforming to the requirements and tested as per methods, specified in IS 4736.

9 STRAIGHTNESS

Unless otherwise agreed to between the purchaser and the manufacturer, tubes shall not deviate from straightness by more than 1 mm in any 600 mm length.

10 LENGTHS

The tubes shall normally be supplied in random lengths

at 4 to 7 m. If ordered in exact lengths, the tolerances shall be subject to prior agreement between the manufacturer and the purchaser.

11 MECHANICAL TESTS

11.1 The following mechanical tests shall be carried out on the selected tube. For mechanical tests, tubes shall be sampled in accordance with IS 4711.

11.2 Tensile Test

The tensile strength, the yield stress and the percentage elongation shall be determined in accordance with the methods specified in IS 1608 and shall be not less than the values specified for the relevant grades of tubes given in Table 2.

11.2.1 The tensile test shall be made on,

- length cut from the end of the selected tube (the ends of the length being plugged for grips, where necessary); or
- a longitudinal strip cut from the tube, not including the weld, if any, and tested in the curved condition, the choice resting with the manufacturer.

Table 2 Tensile Properties of Steel Tubes for Structural Purposes
(Clauses 3.1 and 11.2)

Sl No.	Grade	Tensile Strength Min	Yield Strength Min	Elongation on Gauge Length $5.65\sqrt{S_0}$, Min
(1)	(2)	MPa (3)	MPa (4)	Percent (5)
i)	YSt 210	330	210	20
ii)	YSt 240	410	240	17
iii)	YSt 310	450	310	14
iv)	YSt 355	490	355	10

NOTES

1 1 MPa = 1N/mm² = 0.102 kgf/mm².

2 Elongation percent for tubes up to and including 25 mm nominal bore for all grades shall be 12 minimum.

11.3 Ductility Test

11.3.1 Cold Bend Test (Up to and Including 50 mm NB)

Table 4 Flattening Requirement in Metal
(Clause 11.3.2)

Sl No.	Manufacturing Process Metal	Steel Grade	Weld (Distance Between the Plates)	Parent (Distance Between the Plates)
(1)	(2)	(3)	(4)	(5)
i)	HFS/CDS/ERW/HFIW	YSt 210	75 percent of OD ¹⁾	60 percent of OD
ii)	HFS/CDS/ERW/HFIW	YSt 240	85 percent of OD	75 percent of OD
iii)	HFS/CDS/ERW/HFIW	YSt 310	85 percent of OD	75 percent of OD
iv)	HFS/CDS/ERW/HFIW	YSt 355	85 percent of OD	75 percent of OD

¹⁾ OD = Outside diameter.

Table 3 Steel and Supply Conditions
(Clause 5.1)

Sl No.	Manufacturing Process	Steel	Supply Conditions
(1)	(2)	(3)	(4)
i)	HFW	IS 10748	Only YSt 210 or YSt 240
ii)	HFS/CDS	Bars/ingots with suitable Chemical composition as per IS 10748 to achieve mechanical for respective grades	YSt 210, YSt 240, YSt 310 or YSt 355
iii)	ERW/HFIW	IS 10748	YSt 210, YSt 240, YSt 310 or YSt 355 as welded, heat treated or cold drawn and normalized

NOTE — If required the copper bearing steel may be used to impart weather resistant properties in the steel. Copper content shall be between 0.20 to 0.35 percent subject to mutual agreement between the supplier and the purchaser.

When tested in accordance with IS 2329 an unfilled length of tube shall be capable of being bent cold by tube bending machine around a grooved former (with radius at bottom of the groove equal to 6 × O. D. of the tube) through 180° (with weld at 90° to the plane of bending) without showing any crack at the weld or the metal.

11.3.2 Flattening Test (Tubes Above 50 mm NB)

Rings, not less than 40 mm in length cut from the ends of selected tubes with edges rounded shall be flattened between parallel plates with the weld, if any, at 90° (point of maximum bending) in accordance with IS 2328. No opening shall occur by fracture in the weld until the distance between the plates is less than the value specified for each grade in col 4 of Table 4 and no cracks or breaks in the metal elsewhere than in the weld shall occur until the distance between the plates is less than the value specified for each grade in col 5 of Table 4.

11.4 Re-Test

Should any one of the test pieces first selected fail to pass any of the tests specified, two further samples shall be selected for testing in respect of each failure from the same lot. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test samples shall be deemed as not complying with the standard or the manufacturer may select to test individually the remaining lengths in the lot for the test failed to comply in the preceding tests.

11.5 Sampling

11.5.1 *Sampling of Tubes*

For the purpose of drawing samples all mild steel tubes bearing same designation and manufactured under a single process shall be grouped together to constitute a lot. Each lot shall be sampled separately and assessed for conformity to this specification.

11.5.2 *Sampling and Criterion for Conformity*

Unless otherwise agreed to between the manufacturer and the purchaser the procedure for sampling of tubes

for various tests and criteria for conformity shall be as given in IS 4711.

12 MARKING

12.1 Each tube shall be suitably marked with the manufacturer's name or trade-mark, grade of the steel.

12.1.1 *BIS Certification Marking*

The tubes may also be marked with the Standard Mark.

12.1.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

13 OILING AND PAINTING

All tubes shall, unless otherwise specified, be varnished, painted or oiled externally.

14 BUNDLING AND PACKING

Where tubes are to be bundled for transport, they shall unless otherwise specified, be packed in accordance with IS 4740.

Bureau of Indian Standards

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

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